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09/730,335	12/04/2000	Charles H. Dennison	MI22-1577	8465

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EXAMINER	
NADAV, ORI	

ART UNIT	PAPER NUMBER
2811	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/730,335	Applicant(s) DENNISON, CHARLES H.
	Examiner ori nadav	Art Unit 2811

-- Th MAILING DATE of this communication appears on the cover sheet with th correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If the period for reply specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication (35 U.S.C. § 133).
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 March 2003*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *57-75 and 78-96* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *57-61* is/are allowed.

6)☒ Claim(s) *62-75,78-81,85 and 89* is/are rejected.

7)☒ Claim(s) *82-84,86-88 and 90-96* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *04 December 2000* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *17*.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Drawings

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, two barrier layers, as recited in claim 57, and a gate consisting of conductively doped semiconductor material of the first type and a conductive diffusion barrier layer, as recited in claim 85, must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Objections

2. Claim 94 is objected to because of the following informalities: The phrase "comprising at" should read "comprises". Appropriate correction is required.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 62-64, 67-68, 70-71, 80-81, 85 and 89 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pfiester (4,997,785) in view of Wu (5,710,454) and Hachiya (5,244,835) or Dennison (5,637,525).

Pfiester teaches in figure 7 and related text an Integrated circuitry comprising: a field effect transistor including a gate, a gate dielectric layer, source/drain regions 24, 26 and a channel region; the gate comprising semiconductive material 16 conductively doped with a conductivity enhancing impurity of a first type N+ and a conductive diffusion barrier layer 30 effective to restrict diffusion of first or second type conductivity enhancing impurity, wherein the semiconductive material within the insulating material contacts the conductive diffusion barrier layer of the gate, and wherein the conductive diffusion barrier layer is received over the gate semiconductive material, and the semiconductive material within the insulating material is received over the gate..

Pfiester does not teach a contact structure extending through the insulative material to the gate, wherein the contact structure including a semiconductive material provided through the insulative material being conductively doped with a conductivity enhancing

impurity of a second type P+, such that the conductive diffusion barrier layer of the gate being provided between the gate semiconductive material and the semiconductive material provided through the insulative material. That is, Pfiester does not teach a contact structure including a semiconductive material provided through insulative material 44 or any insulative material surrounding the gate, being conductively doped with a conductivity enhancing impurity of a second type P+ and making contact to layer 20 having a conductivity enhancing impurity of a second type P+.

Wu teaches in figure 3 and related text a contact structure extending through insulative material 22a to the gate, wherein the contact structure including a semiconductive material provided through the insulative material being conductively doped with a conductivity enhancing impurity of a conductivity type, such that the conductive diffusion barrier layer of the gate being provided between the gate semiconductive material and the semiconductive material provided through the insulative material, the insulative material comprises an opening substantially void of any conductive diffusion barrier layer material. wherein neither of the contact structure sidewalls aligning with either of the opposing sidewalls of the gate in one cross section (column 10, lines 51-58).

Hachiya teaches in figure 4 a contact structure 16N including a semiconductive material being conductively doped with a conductivity enhancing impurity of a first N+ type making contact to a region of a semiconductive material being conductively doped with a conductivity enhancing impurity of a first N+ type, and a contact structure 17P including a semiconductive material being conductively doped with a conductivity

enhancing impurity of a second P+ type making contact to a region of a semiconductive material being conductively doped with a conductivity enhancing impurity of a second P+ type.

Dennison teaches in figure 11 a contact structure 54 including a semiconductive material being conductively doped with a conductivity enhancing impurity of a first N+ type making contact to a region 56 of a semiconductive material being conductively doped with a conductivity enhancing impurity of a first N+ type, and a contact structure 40 including a semiconductive material being conductively doped with a conductivity enhancing impurity of a second P+ type making contact to a region 42 of a semiconductive material being conductively doped with a conductivity enhancing impurity of a second P+ type.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a contact structure extending through the insulative material to the gate, wherein the contact structure including a semiconductive material provided through the insulative material being conductively doped with a conductivity enhancing impurity, as taught by wu, of a second type P+, as taught by Hachiya and Dennison, such that the conductive diffusion barrier layer of the gate being provided between the gate semiconductive material and the semiconductive material provided through the insulative material in Pfiester's device, in order to operate the device by providing external connections to the gate, and in order to simplify the processing steps of making the device and to reduce the contact resistance and the device characteristics,

respectively. The combination is motivated by the teachings of Pfiester who points out that the device can be used in an application which requires a contact structure contacting the gate, and by the teachings of Hachiya and Dennison who point out the advantages of using a contact structure of one conductivity type to make contact to a region of the same conductivity type.

Regarding claim 64, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a first type p and a second type n in Pfiester's device, in order to use the device in an application which requires electrical contact to the NMOS.

Regarding claim 68, the semiconductive material within the insulating material of prior art's device does not contact the conductive diffusion barrier layer of the gate.

Regarding claim 85, Pfiester teaches in figure 7 one gate electrode consists of a conductivity doped semiconductive material of the first type 16 and a conductive diffusion barrier layer 30.

Regarding claim 89, Pfiester teaches in figure 7 a gate electrode can alternatively consist of a conductivity doped semiconductive material of the first type 16, a conductive diffusion barrier layer 30 and a conductive silicide 20.

5. Claims 65, 66, 69, 72, 74 and 78 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pfiester, Wu, Hachiya and Dennison, as applied to claim 62 above, and further in view of Ku (5,856,237).

Regarding claim 65, Pfiester, Wu, Hachiya and Dennison teach substantially the entire claimed structure, as applied to claim 62 above, except a gate also comprises a conductive silicide.

Ku teaches in figure 4F a gate comprises a conductive diffusion barrier layer 140 selected from the group consisting of WxNy, TiOxNy, and TiWxNy, and mixtures thereof over a conductive silicide 124 comprising TiSi.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a gate also comprises a conductive silicide in prior art's device, in order to reduce the contact resistance of the gate.

Regarding claim 66, the silicide and the conductive diffusion barrier layer comprise the same material, Titanium.

6. Claim 73 is rejected under 35 U.S.C. 103(a) as being unpatentable over Pfiester, Wu, Hachiya, Dennison and Ku, as applied to claim 72 above, and further in view of Chow et al. (4,847,111) and Charneski et al. (5,909,637)..

Pfiester, Wu, Hachiya, Dennison and Ku teach substantially the entire claimed structure, as applied to claim 72 above, except a conductive diffusion barrier layer comprising WxNy.

Chow et al. teach in figure 1c a conductive diffusion barrier layer comprising WxNy.

Charneski et al. teach a conductive diffusion barrier layer comprising WxNy, TiOxNy, TiN and TiWxNy (column 10, lines 20-22).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a conductive diffusion barrier layer comprising WxNy in prior art's device, in order to prevent diffusion and to strengthen the adhesion, and because TiOxNy, TiN and WxNy are conventional interchangeable materials used as conductive barrier diffusion layers in a gate electrode. Note that substitution of materials is not patentable even when the substitution is new and useful. Safetran Systems Corp. v. Federal Sign & Signal Corp. (DC NIII, 1981) 215 USPQ 979.

7. Claim 75 is rejected under 35 U.S.C. 103(a) as being unpatentable over Pfiester, Wu, Hachiya, Dennison and Ku, as applied to claim 72 above, and further in view of Igarashi and Charneski et al. (5,909,637)..

Pfiester, Wu, Hachiya, Dennison and Ku teach substantially the entire claimed structure, as applied to claim 72 above, except a conductive diffusion barrier layer comprising TiWxNy.

Igarashi teaches a gate electrode comprising TiN or TiWxNy (column 4, lines 4-9).

Charneski et al. teach a conductive diffusion barrier layer comprising WxNy, TiOxNy, TiN and TiWxNy (column 10, lines 20-22).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a conductive diffusion barrier layer comprising TiWxNy in prior art's device, in order to prevent diffusion and to strengthen the adhesion, and because TiOxNy, TiN and TiWxNy are conventional interchangeable materials used as conductive barrier diffusion layers in a gate electrode. Note that substitution of materials is not patentable even when the substitution is new and useful. Safetran Systems Corp. v. Federal Sign & Signal Corp. (DC NIII, 1981) 215 USPQ 979.

8. Claims 65 and 79 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pfiester, Wu, Hachiya and Dennison, as applied to claim 62 above, and further in view of Bai et al. (5,818,092).

Pfiester, Wu, Hachiya and Dennison teach substantially the entire claimed structure, as applied to claim 62 above, except a gate also comprises a conductive silicide over a conductive diffusion barrier layer.

Bai et al. teach in figure 2C a conductive silicide 220 over a conductive diffusion barrier layer 206.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a gate also comprises a conductive silicide over a

conductive diffusion barrier layer in prior art's device, in order to reduce the contact resistance of the gate.

Allowable Subject Matter

9. Claims 57-61 are allowed.

10. Claims 82-84, 86-88 and 90-96 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Reasons for allowance

11. The following is an examiner's statement of reasons for allowance: Prior art does not teach a conductive diffusion barrier layer comprising WxNy and TiWxNy, and a conductive diffusion barrier layer comprising TiOxNy and TiWxNy

Response to Arguments

12. Applicant argues that the drawings show every feature of the claimed invention, because the two barrier layers recited in claim 57 do not have to be two barrier layers, but rather one barrier layer comprising a mixture of the recited materials. Applicant further argues that claim 39 supports a mixture of the materials recited in claim 57.

Claims are interpreted in light of the specification. Although claim 39 recites a mixture of the materials recited in claim 57, there is no support in the specification for a mixture of the materials, as recited in claim 57, in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The specification also do not describe a mixture of materials in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. .

13. Applicant argues that modifying Pfiester's structure would render Pfiester's device inoperative, because the contact opening would be formed through the transistor channel 36 and the upper gate oxide 44.

A transistor comprises a gate electrode surrounded by an insulative material, and a channel region electrically insulated from the gate electrode by part of the insulative material called a gate oxide. A contact must be made to the gate electrode, through the insulative material in order to operate the device. An artisan recognizes

and understands that the contact structure can not electrically contact the channel region of the transistor.

Pfiester teaches a shared gate transistor having channel regions above and below the gate structure, wherein the gate electrodes are surrounded by an insulative material. It is clearly understood that in order to operate Pfiester's device, a contact must be made to the gate electrodes, through the insulative material, wherein the contact structure can not electrically contact the channel regions of the transistor. An artisan recognizes and understands that the contact structure can not electrically contact the channel region of Pfiester's transistor. Therefore, a contact structure contacting the gate electrode through the surrounding insulative material can be formed, and must be formed, in Pfiester's structure, in order to operate the device, without disabling the device and without rendering it inoperative..

Conclusion

14. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within

TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Papers related to this application may be submitted to Technology center (TC) 2800 by facsimile transmission. Papers should be faxed to TC 2800 via the TC 2800 Fax center located in Crystal Plaza 4, room 4-C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (November 15, 1989). The Group 2811 Fax Center number is (703) 308-7722 and 308-7724. The Group 2811 Fax Center is to be used only for papers related to Group 2811 applications.

Any inquiry concerning this communication or any earlier communication from the Examiner should be directed to *Examiner Nadav* whose telephone number is **(703) 308-8138**. The Examiner is in the Office generally between the hours of 7 AM to 4 PM (Eastern Standard Time) Monday through Friday. If attempts to reach the examiner by

telephone are unsuccessful, the examiner's supervisor, Tom Thomas, can be reached at **(703) 308-2772.**

Any inquiry of a general nature or relating to the status of this application should be directed to the **Technology Center Receptionists** whose telephone number is **308-0956**

O.N.
May 6, 2003

ORI NADAV
PATENT EXAMINER
TECHNOLOGY CENTER 2800